EEE104
Circuit Analysis I

Ankara University

Faculty of Engineering

Electrical and Electronics Engineering Department

Response of First Order RL Circuits
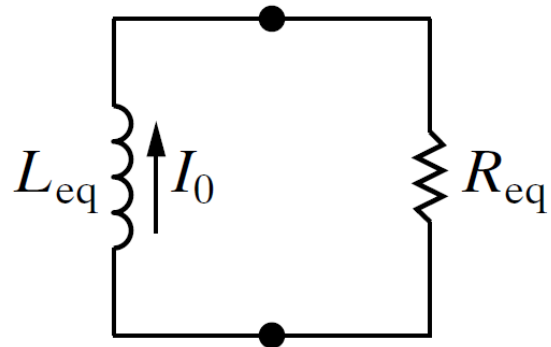
EEE104 Circuit Analysis I
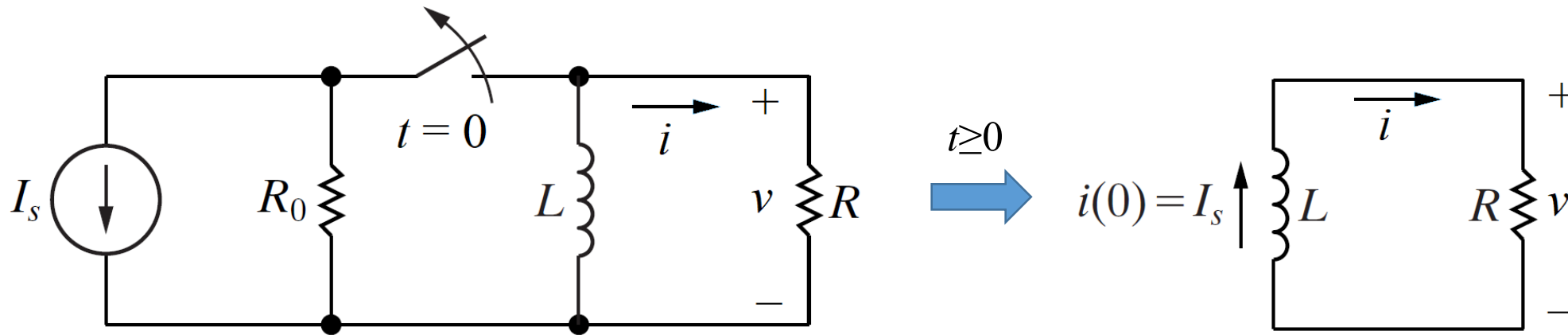
Lecture 10

Agenda

- Natural Response of an RL Circuit
- Natural Response of an RC Circuit

- ## Natural Response of an RL Circuit

Natural Response Form of RL Circuit

- Natural Response of an RL Circuit

A circuit for RL circuit natural response

- Natural Response of an RL Circuit

$$i(0^-) = i(0^+) = I_0$$

$$i(t) = I_0 e^{-\left(\frac{R}{L}\right)t}, t \geq 0 \qquad\qquad \tau = \frac{L}{R} \quad \rightarrow i(t) = I_0 e^{-\frac{t}{\tau}}, t \geq 0$$

$$v(t) = i(t)R = I_0 R e^{-\left(\frac{R}{L}\right)t}, t \geq 0^+ \qquad\qquad v(t) = V_0 e^{-\frac{t}{\tau}}, t \geq 0^+$$

$$v(0^-) = 0$$
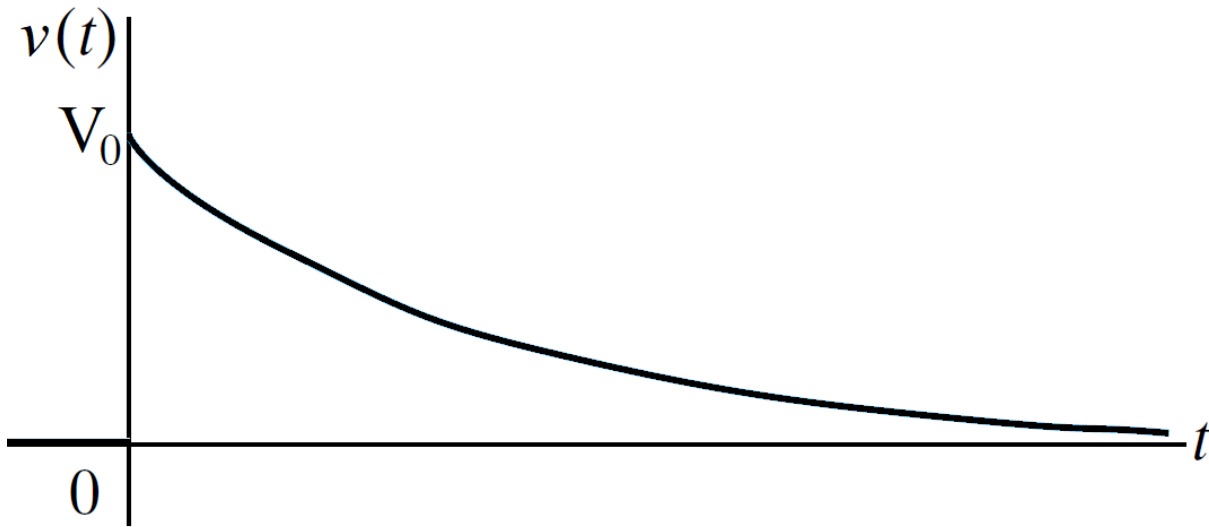
$$v(0^+) = I_0 R = V_0$$

- Natural Response of an RL Circuit
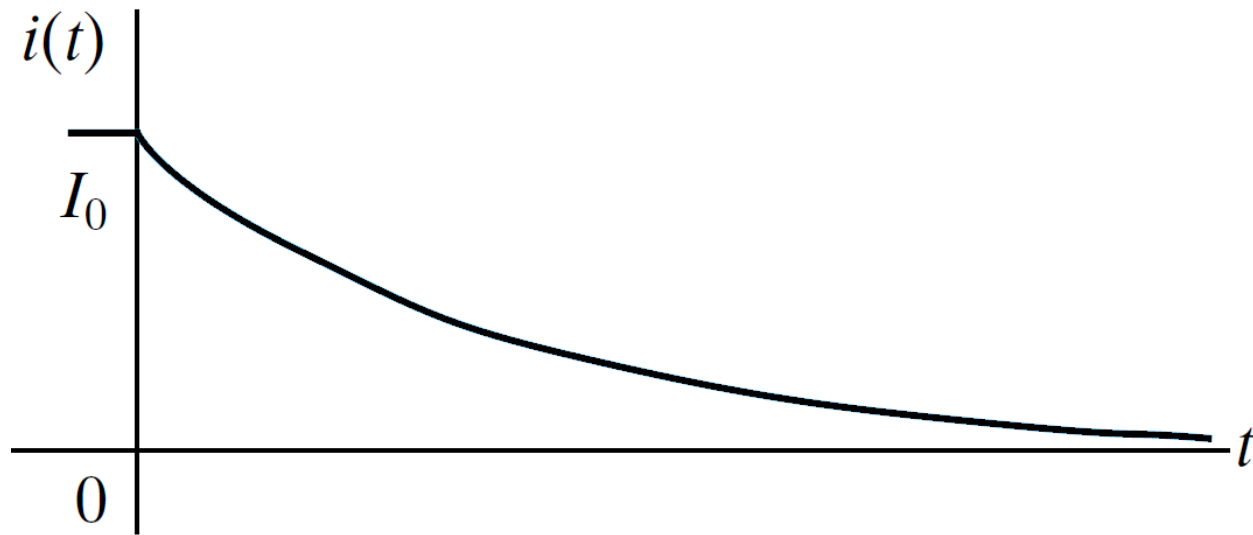
Natural current response of RL circuit
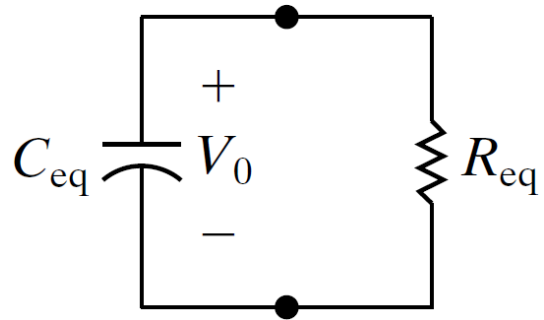
- Natural Response of an RL Circuit

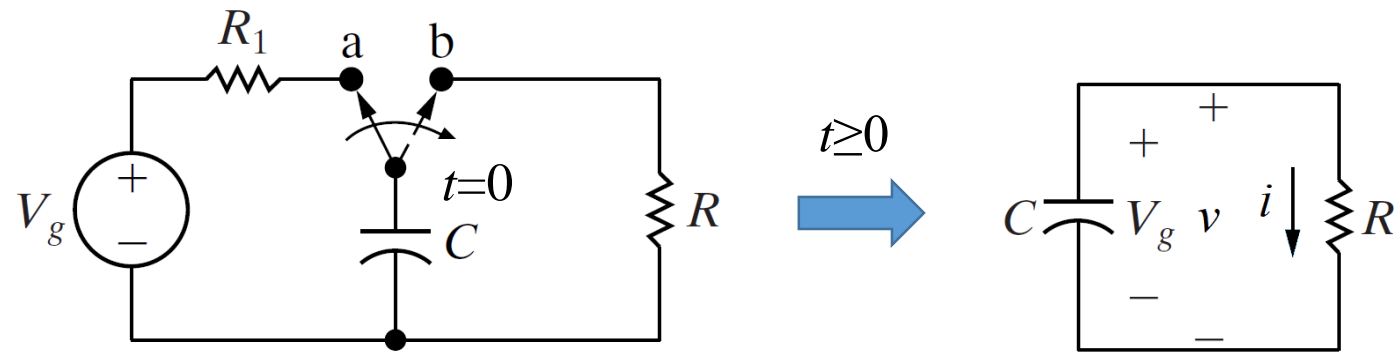Natural voltage response of RL circuit

- Natural Response of an RC Circuit

Natural Response Form of RC Circuit

- ## Natural Response of an RC Circuit

A circuit for RL circuit natural response

- Natural Response of an RC Circuit

$$v(0^-) = v(0^+) = V_0$$

$$v(t) = V_0 e^{-\frac{t}{RC}}, t \geq 0 \qquad \tau = RC \quad \rightarrow v(t) = V_0 e^{-\frac{t}{\tau}}, t \geq 0$$
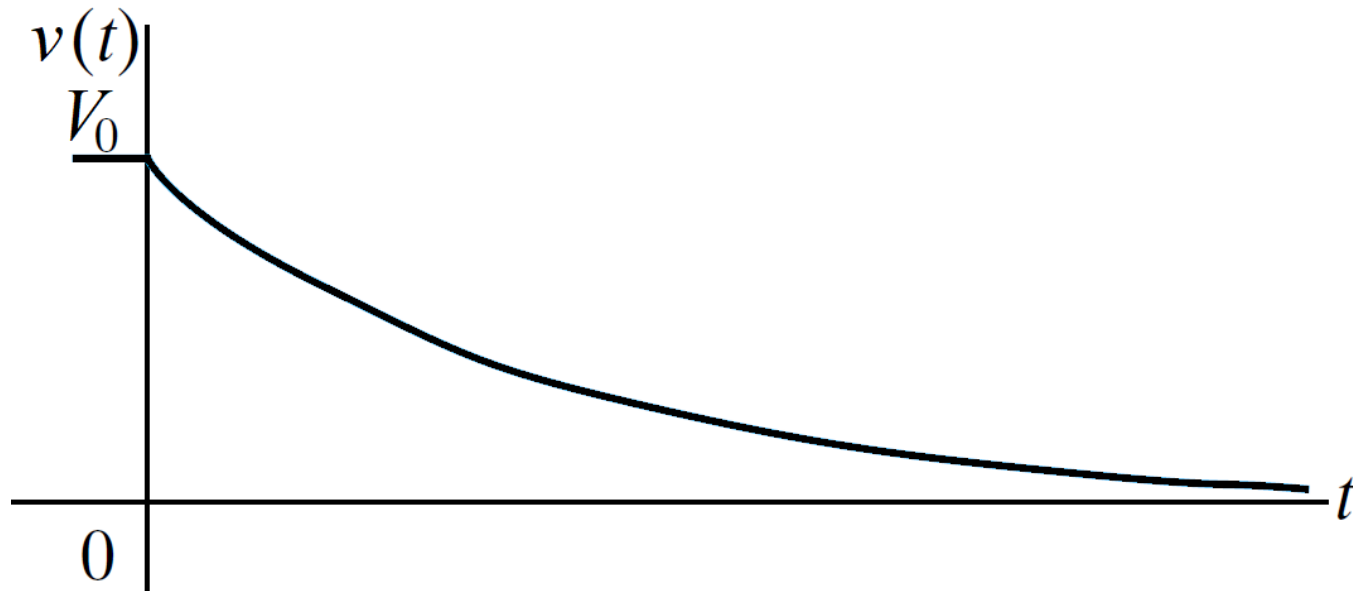
$$i(t) = \frac{v(t)}{R} = \frac{V_0}{R} e^{-\frac{t}{RC}}, t \geq 0^+ \qquad i(t) = I_0 e^{-\frac{t}{\tau}}, t \geq 0^+$$
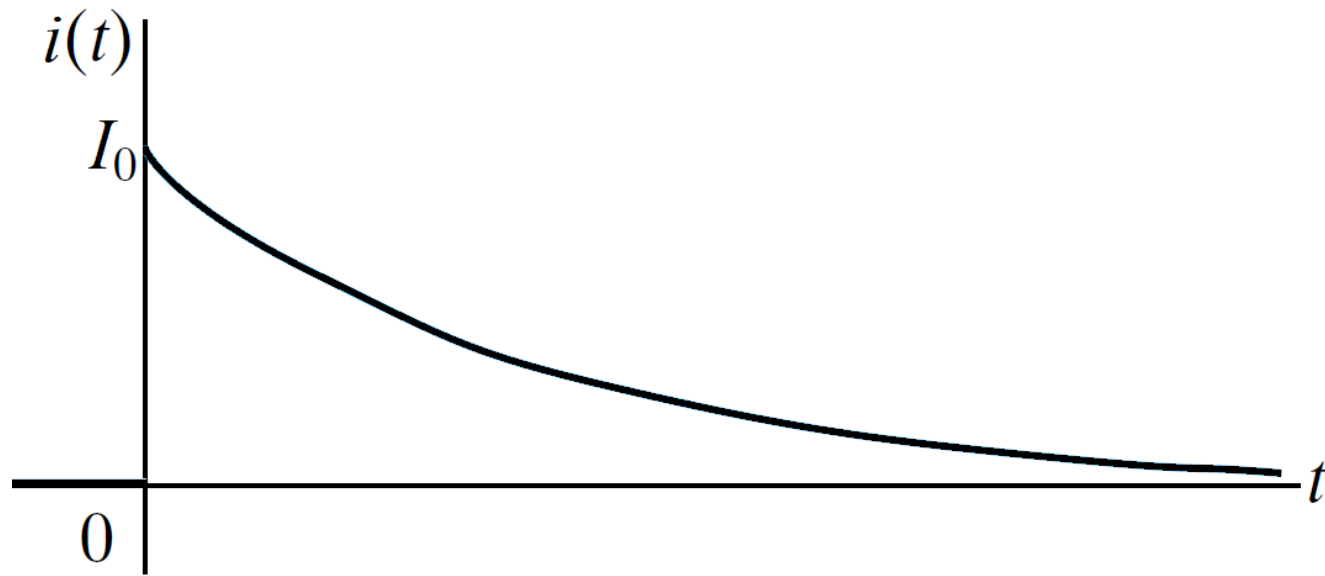
$$i(0^-) = 0$$

$$i(0^+) = \frac{V_0}{R} = I_0$$

- Natural Response of an RC Circuit

Natural voltage response of RC circuit

- Natural Response of an RC Circuit

Natural current response of RC circuit

Reference

- Electric Circuits, Tenth Edition, James W. Nilsson, Susan A. Riedel Pearson, 2015